Annals of Clinical and Analytical Medicine
Original Research

The role of the HEART score in the discharge of patients admitted to the emergency department with chest pain

The role of heart score

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Abstract
Aim: In this study, we aimed to determine the incidence of major adverse cardiac events within 6 weeks after discharge of patients admitted to the emergency department (ED) with chest pain and a HEART score of 0-3, and to determine the role of the HEART score in the discharge decision of low-risk patients for acute coronary syndrome from the ED.
Material and Methods: Out of 625 patients admitted to the ED with chest pain, 200 patients with a HEART score of 0-3 were included in the study.
Results: Of the 200 patients included in the study, 199 (99.5%) were discharged from the ED, and 1 patient (0.5%) prediagnosed with unstable angina pectoris was hospitalized in the coronary intensive care unit of an external center. The patient did not undergo angiography in the coronary intensive care unit and was discharged after 24 hours of observation. Angiography was performed in 3 (1.5%) of 199 patients discharged from the ED and was recommended in 1 patient (0.5%) who refused it. Coronary artery disease was detected in 1 of 3 patients who underwent angiography, but a stent was not placed. The angiography results of 2 patients were evaluated as normal. No major adverse cardiac events were seen in any of the 200 patients (0%) at the end of the 6-week follow-up period.
Discussion: The HEART score can guide the emergency physicians in making decisions about the discharge of patients admit to ED with chest pain and at low risk of developing an acute coronary syndrome.

Keywords
Chest Pain, Acute Coronary Syndrome, Risk Score

DOI: 10.4328/ACAM.21622 Received: 2023-01-27 Accepted: 2023-03-02 Published Online: 2023-03-11 Printed: 2023-03-25 Ann Clin Anal Med 2023;14(Suppl 1):S51-55
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This study was approved by the Ethics Committee of University of Health Sciences, Dışkapı Yıldırım Beyazıt Training and Research Hospital (Date: 2018-12-17, No: 57/02)

Introduction

Chest pain is one of the most common reasons for admission to emergency departments (ED). 13-25% of patients with chest pain have acute coronary syndrome (ACS) [1, 2]. ACS is a clinical spectrum with high morbidity and mortality, so early diagnosis and intervention are important for physicians [1, 2]. The diagnosis of ACS in patients with significant ST segment and T wave changes or typical changes in cardiac markers on electrocardiography (ECG) is easy, but difficult without significant change in ECG and cardiac markers. Difficulty in diagnosis can cause problems such as unnecessary investigation, prolonged hospital stay, increased health workload and costs [3].

ED physicians use guidelines for the management of patients with chest pain. The ACC/AHA (American College of Cardiology/ American Heart Association) guideline recommends patients with suspected ACS be classified as low, intermediate or high risk; treatment and discharge decisions are made according to this classification [4].

The HEART score was developed by AJ Six, BE Backus, and JC Kelder to classify patients admitted to ED with chest pain as low, moderate, and high risk for having a short-term major adverse cardiac event (MACE), including acute myocardial infarction (AMI), percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG) and death, and to specify low-risk patients who can be discharged early from ED [5]. The HEART score has five variables: history, ECG, age, risk factors, and troponin. For each parameter, patients are scored between 0-2 and the total value is 10. Patients with a HEART score of 0–3 are considered low risk, 4-6 intermediate risk and 7–10 high risk. The HEART score was developed based on clinical experience and literature, so it is easier to use in ED compared to other prediction rules. The score can guide emergency physicians for discharge decision of low-risk patients for ACS from ED [3]. The study aimed to determine the incidence of MACE within 6 weeks after discharge of patients admitted to the ED with chest pain and a HEART score of 0-3, and also to determine the role of the HEART score in discharge decisions of low-risk patients for ACS.

Material and Methods

This study is a prospective observational study and was carried out in the emergency department of the University of Health Sciences Dışkapı Yıldırım Beyazıt Training and Research Hospital between December 18, 2018 and January 19, 2019. The study was approved by the Ethics Committee of University of Health Sciences, Dışkapı Yıldırım Beyazıt Training and Research Hospital (Date: 2018-12-17, No: 57/02).

Patients over 18 years of age who admitted to the ED with chest pain, with suspected ACS, who had a HEART score of 0-3, who agreed to participate in the study, and signed a consent form were included in the study. Patients with a significant ST segment elevation on the ECG and requiring urgent invasive intervention, patients with shortness of breath, dizziness, tachycardia, and arrhythmia, with hemodynamic instability, using digoxin and not agreeing to participate in the study were excluded.

Patients' age, gender, nature of chest pain (characteristics, location, time of onset, whether chest pain persists, duration, spread area), additional symptoms, ECG findings, risk factors (obesity, hypertension, diabetes mellitus, hyperlipidemia, previous MI, cerebrovascular disease, peripheral arterial disease, PCI and CABG history) and troponin levels were evaluated. The HEART score was calculated.

HEART Score Calculation

In the history, factors, described above as the nature of chest pain for assessing typical or atypical chest pain for ACS, were questioned.

Pain in the left hemithorax or retrosternal area, spreading to the left arm or back, accompanied by autonomic symptoms such as nausea, vomiting and sweating, and lasting between 5 and 20 minutes or longer was classified as typical and scored 2 points. If the history was not compatible with typical pain and ACS was not suspected, pain was classified atypical and given 0 points. One point was given if the patient's pain had characteristics of both typical and atypical pain and increased suspicion for ACS. The history parameter was collected in 3 groups: highly, moderately, and slightly suspicious (Table 1).

MI, PCI, CABG, and sudden cardiac death were defined as MACEs. Patients included in the study were called 6 weeks after discharge by the investigators to learn whether they had MACE or not and, if so, to identify the event.

Statistical analysis

The SPSS 17.0 (for Windows) package program was used for data analysis. The findings obtained from the data form were demonstrated by frequency analysis. The homogeneity of data distribution was evaluated with the Kolmogorov-Smirnov test. The Mann-Whitney U test was used to compare the two groups. The Kruskal-Wallis H test was used for multi-group comparisons. $P<0.05$ was considered statistically significant.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

Of the 200 patients included in the study, 109 (54.5%) were male and 91 (45.5%) were female. The mean age of the patients was 38.93+11.72 (min. 18-max. 75); 101 patients had stinging chest pain, which was the most common (50.5%) type of pain. The most common location of pain was the left hemithorax in 106 (53%) patients. No spread of pain was described in 116 (58%) patients. There were no additional symptoms in 158 (79%) patients. At the time of admission, 144 patients (72%) stated that they had pain, and 56 patients (28%) stated that they had no pain (Table 2).

History of 35 (17.5%) patients was evaluated as highly suspicious, 59 (29.5%) as moderately suspicious, and 106 (53%) as slightly suspicious. ECG of 122 patients (61%) was normal, 73 patients (36.5%) had nonspecific repolarization anomalies in ECG and 5 patients (2.5%) had significant ST segment depression or T wave inversion.

Obesity, chronic disease history, family history of coronary artery disease, and smoking were questioned as risk factors. Twelve patients (6%) were obese, 69 (34.5%) patients had a family history of coronary artery disease, 99 (49.5%) patients were current smokers and 53 patients (26.5%) had chronic diseases. One hundred twenty-six (63%) patients had 1 or 2

Table 1. HEART Score

Parameter		Point
History	Slightly suspicious	0
	Moderately suspicious	1
	Highly suspicious	2
Electrocardiography	Normal	0
	Nonspecific repolarization abnormalities	1
	Significant ST-segment deviation	2
Age (year)	<45	0
	45-65	1
	>65	2
Risk factors	None	0
	1 or 2	1
	>3	2
Troponin level	< Normal	0
	1-3x normal	1
	>3x normal	2

Table 2. Characteristics and additional symptoms of chest pain in patients.

Chest Pain	Feature	(n)	%
Characteristic	Stinging	101	50.5
	Squeezing	22	11
	Stabbing	22	11
	Burning	15	7.5
	Pressure	14	7
	Other	26	13
Location	Left hemithorax	106	53
	Retrosternal	36	18
	Diffuse	30	15
	Right hemithorax	16	8
	Epigastric	12	6
Area of extent	None	116	58
	Left arm	39	19.5
	Back	36	18
	Neck-jaw	5	2.5
	Right arm	4	2
Additional symptoms	None	158	79
	Nausea-vomiting	15	7,5
	Palpitation	12	6
	Lassitude	5	2,5
	Sweating	4	2
	Other	6	3

risk factors and 17 patients (49.5%) had 3 or more risk factors. Two (1%) patients' troponin levels increased in the range of 1-3 times the normal limit.

When the HEART score points were evaluated, 5 (2.5%) patients received 0 points, 41 (20.5%) patients received1 point, 66 (33%) patients received 2 points, and 88 (44%) patients received 3 points (Table 3).

By gender (p=0.409), smoking (p=0.094), the spread of pain (p=0.637), symptoms accompanying chest pain (p=0.625), ECG findings (p=0.558) and troponin levels (p=0.140) subgroups, there was no statistically significant difference for the HEART score (p>0.05). Age (p<0.01), obesity (p=0.045), chronic

Table 3. Distribution of patients by HEART score subgroups.

Subgroup	Feature	Point	(n)	%
History	Highly suspicious	2	35	17.5
	Moderately suspicious	1	59	29.5
	Slightly suspicious	0	106	53
EKG	Marked ST-segment depression	2	5	2.5
	Nonspecific repolarization abnormalities	1	73	36.5
	Normal	0	122	61
Age (year)	>65	2	6	3
	45- 65	1	53	26.5
	<45	0	141	70.5
Risk factors	>3	2	17	8.5
	1 or 2	1	126	63
	None	0	57	28.5
Troponin levels	>3 times	2	2	1
	1-3 times	1	0	0
	Normal	0	198	99

disease history (p=0.008), family history of coronary artery disease (p=0.035), character (p<0.01) and location of chest pain (p=0.049) are the parameters, which have a statistically significant difference between subgroups for the HEART score (p<0.05).

The HEART score had a statistically significant difference between the age groups (p<0.01). Positive correlation between age and the HEART score was found. The HEART score increased as age increased. Patients with obesity had a higher HEART score than those without obesity, and this difference was significant statistically (p=0.045). Furthermore, the HEART score was different between chronic disease history subgroups, and the difference was statistically significant (p<0.008). Patients with PCI and CABG surgery history had the highest HEART scores, while patients with hypercholesterolemia patients the lowest. The HEART score of patients with a family history of coronary artery disease was found to be higher which was statistically significant (p=0.035). The HEART score was higher in patients with pressure, squeezing and burning chest pain than with stinging chest pain (p<0.01).

Patients with epigastric pain had the highest HEART scores, followed by retrosternal, left hemithorax, diffuse, and right hemithorax pain, respectively, and the difference was statistically significant (p=0.049).

Only 1 (0.5%) of 200 patients included in the study, prediagnosed with unstable angina pectoris was hospitalized in the coronary intensive care unit of the external center and 199 patients (99.5%) were discharged from the ED. In the patient hospitalized in the coronary intensive care unit, it was confirmed that no angiography was performed and the patient was discharged after 24 hours of observation.

Angiography was performed in 3 patients (1.5%) after discharge. Coronary artery disease was diagnosed in 1 patient (0.5%), but no stent was placed. Angiography results were normal in 2 patients (1%). Angiography was recommended to 1 patient (0.5%), but the patient refused it. No MACE developed during the follow-up of the patients included in the study.

Discussion

This study aims to determine the incidence of MACEs after discharge of patients admitted to the ED with chest pain and at low risk for ACS, and also to evaluate the role of the HEART score in the discharge decision of these patients. The most important result of the study is the low incidence of MACEs in the low-risk patient group. This study is remarkable because, to the best of our knowledge, it is the first study on this subject in our country.

Chest pain is one of the most common causes of admission to EDs worldwide, as in our country [6,7]. The diagnosis of ACS in patients who have chest pain and significant ST-segment elevation, ST-segment depression, or elevated cardiac markers is easy; however, some patients have no changes in their ECG or cardiac markers [5,9]. Dustin et al. reported that 1–4% of patients without ECG or cardiac marker changes were diagnosed with significant coronary artery disease on angiography [8]. A missed diagnosis of ACS will result in patients being discharged inappropriately and having MACEs, an increase in inappropriate health practices and physicians facing legal consequences. Jain et al found that the rate of discharge of patients from the ED, despite the presence of ACS, was 2–4%, and the 30-day mortality was as high as 9.1% in this group [10].

Guidelines recommend risk stratification for the management of patients with suspected ACS. It is thought that missed diagnosis rate of ACS decreases over time with different assessment strategies, such as prediction rules for risk classification, and this rate varies between 2-10% [11, 12]. Mahler et al. found that missed diagnosis rate in patients discharged using a prediction rule was <0.05% [13].

The ideal prediction rule for EDs should reliably and effectively identify all patients at low risk for ACS or MACE and they can be discharged safely [2,14].

The HEART score was developed for risk stratification in patients admitted to ED with chest pain [15,16]. In the first published study on the HEART score, the incidence of MACEs was 2.5% in patients with a HEART score of 0-3, and it was stated these patients could be discharged from ED [16]. Similarly, in another study, patients with a HEART score of 0-3 were found to be at low risk for ACS, the incidence of MACEs was 0.99%, and it was mentioned that patients with a HEART score of 0-3 could be discharged from ED early [3].

Similar to initial results, in different studies, the incidence of MACEs has been found to be 0.6-2.5% in patients at low risk. Based on these results, regardless of the cause of chest pain, the HEART score has been reported to have good to excellent efficacy in distinguishing patients at risk of developing MACEs in EDs [3,5,13]. As a result of this study, patients admitted to the ED with chest pain and having a HEART score between 0-3 developed no MACE after discharge. In a survey of 1029 clinicians who participated, 41% stated that <1% and 56.8% stated that missed diagnosis rate of 0.5% could be accepted [17]. In an article published in our country in 2018, this rate was reported as <1% [16].

The HEART score may have an advantage for clinicians that ECG findings are scored in three categories and non-specific ST segment anomalies are classified in a separate group, which is important to avoid missing non-specific ECG anomalies and to reduce missed diagnosis.

Another important advantage of the HEART score is the reduction of costs and economic burden on the health system. Poldervaart et al. found that the HEART score was more cost-effective than the traditional clinical approach [18]. In terms of reducing costs the HEART score does not need a specific kit for troponin measurement. There may be slight differences between various troponin measurements in hospitals, but this does not cause a significant difference in the HEART score results [16].

On the other hand, as advantages there are controversial aspects of the HEART score, such as evaluation of history and ECG may differ on interpretation. Different interpretations of history and ECG will result in a HEART score lower or higher than it should be [16].

Studies have shown that the HEART score was calculated lower by cardiologists compared to emergency physicians and higher by senior physicians compared to less experienced physicians for patients at the border for low and moderate risk [19,20].

In order to prevent bias in this study while evaluating history and ECG, parameters of history were questioned with options in data collection form, and also history parameters and ECG findings were evaluated by a single investigator.

While using the HEART score, ED physicians should be cautious of patients with unstable angina pectoris (USAP). USAP diagnosis is based on the history, so these patients have a low-risk HEART score, and this may result in missed diagnosis and inappropriate discharges [16].

Another issue observed during this study is that the HEART score may be calculated higher inappropriately because laboratory parameters such as kidney function tests and complete blood count, which can affect troponin levels, are not part of the score. Also, many non-cardiac conditions with troponin elevation should be kept in mind [21].

Despite the evaluation of patients with chest pain using the HEART score, some patients with ACS have only angina-like or unusual symptoms. The HEART score is unable to evaluate these patients.

Conclusion

The HEART score may guide emergency physicians in the decision-making process to discharge patients at low risk for ACS. Clinical prediction rules are not perfect and only useful to guide physicians, like the HEART score, which has its own advantages and disadvantages. Physicians should make a final decision by combining clinical evaluation, risk score, and laboratory results.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: *None*

Conflict of interest
None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:
Burcu Doğan, Nezih Kavak, Seval Komut, Safiye Terzi, Engin Deniz Arslan. *The role of the HEART score in the discharge of patients admitted to the emergency department with chest pain. Ann Clin Anal Med 2023;14(Suppl 1):S51-55*

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